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NEWARK

INTERNATIONAL AIRPORT

Data Package Number 5

Airport Capacity Enhancement Design Team Study

November 1997

Prepared by
Federal Aviation Administration
FAA William J. Hughes Technical Center
Atlantic City International Airport, New Jersey

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Information in this document is subject to change as Design Team analysis progresses.

16. Abstract

This interim report contains technical data pertaining to the Newark International Airport Capacity Enhancement Design Team Study.

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Newark International Airport (EWR)

Data Package Number 5

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1. GENERAL DISCUSSION AND MODEL INPUTS

Accepted Model Inputs

The following model inputs were accepted by the Design Team at the last meeting. These inputs will be used in the capacity analyses and simulations. They are described in detail in Appendix A.

- Runway occupancy times and exit probabilities for 11/29.
- Dependencies for parallel runways.
- Gate service times.
- Simulated demand characteristics (demand levels and fleet mixes).
  Gate assignments. (Includes updates for Jet Express and Jet Train Corp. at Terminal A3, and Scandinavian Airlines at Terminal B3.)
- Gate map.

Status of EWR Inputs and Tasks

Exhibit 1 describes the status of the EWR inputs and tasks.

Model Inputs

Exhibit 2 presents miscellaneous input data and questions, such as LAHSO (Land and Hold Short Operations) and runway dependencies.

Exhibit 3 presents the hour counts for each demand level.

Exhibit 4 presents the hour count summary for the 3 demand levels.

Exhibit 5 describes the operational procedures and minima for the EWR weather categories.

Exhibit 6 shows the *observed* weather categories and runway configurations by flow direction.

Exhibit 7 shows the *simulated* weather categories and runway configurations by flow direction.

Exhibit 8 presents the EWR experimental design for the 1996 demand.

Exhibit 9 presents EWR Calibration runway configurations.

EXHIBIT 1 - STATUS OF EWR INPUTS AND TASKS

INPUTS AND TASKS	STATUS
ALPs, Improvements, Simulation Scenarios	DP5
Aircraft Classifications	X
ATC Separations	X
Dependencies between Parallel Runways	X
Other Runway Dependencies	DP5
Operational Procedures and Minima (By Configuration)	DP5
Other Model Inputs	DP5
Annual Demand Levels (1996 and Future Demands)	X
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Fleet Mix Costs	
Annual Delay Costs and Savings	

NOTE: X: The item was previously accepted and appears in Appendix A of this data package.

Dpn: Data Package n.

EXHIBIT 2 - MISCELLANEOUS INPUT DATA FOR EWR

(Revised on 10/10/97)

NOTES:

The Tower and the Tracon provided the following information which should help the Technical Center determine runway assignments and calibrate the model:

- **There is no interleaving of arrivals of 11 and departures on 29.** The VFR D/A separations reflect the transition from departures on 29 to arrivals on 11: when the last departure on 29 starts its roll, the arrival to 11 must be 15 NM from threshold.

- **In the NE Flow, *eastbound* departures are not allowed on 29 because of the difficulty of merging departures on 29 with departures on 4s. Therefore, the NE Flow has fewer departures on 29 (in all weather conditions) than the SW Flow.**

- **NE Flow in VFR-2: The number of departures on 29 is greatly reduced during periods when EWR has arrivals on 11 and departures on 29, and TEB has arrivals on ILS Runway 6.** Departures on 29 must be released between arrivals on TEB's Runway 6. This will also affect EWR in IFR-1a, conditions when DCIA (an improvement) is simulated with arrivals on 11.

LAND and HOLD SHORT OPERATIONS – Calibration:

At the August meeting, the Design Team agreed that the EWR simulations should assume that any aircraft arriving on Runway 11 can land and hold short of 4/22.

The following describe the simulation of arrivals on 11:

NE & SE flows: **Only aircraft who can LAHSO will be permitted to arrive on 11.**
All PROPS can LASHO on 11.
Props are in Classes LC (Large Commuter), MEDIUM, & SMALL.
Regional Jets & Biz Jets *CANNOT* LAHSO on 11.

D/D SEPARATIONS ON 29:

The D/D Separations were modified at the August meeting: **there is a 2 minute D/D separation for all departures on 29 in all weather conditions.**

The new separation provides 5NM in-trail to departures on 29 so they can merge with departures on the parallels. Pages A-6 and A-7 (in Appendix A) were modified to reflect this change in the D/D separations.

EXHIBIT 2 - MISCELLANEOUS INPUT DATA FOR EWR (Cont.)

(Revised on 10/2/97)

OTHER RUNWAY DEPENDENCIES

Dependencies Between 11 & 29 – NE & SW Flows – Calibration

There is no interleaving of arrivals of 11 and departures on 29. The VFR D/A separations reflect the transition from departures on 29 to arrivals on 11: when the last departure on 29 starts its roll, the arrival to 11 must be 15 NM from threshold.

* **Arrival to 11 followed by a Departure 29:**
  VFR-1 & VFR-2: An arrival to 11 must exit the runway before a departure on 29 can start its roll. (Source: Tracon.)
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  A/D separation: VFR-1 & VFR-2: 1 minute. IFR1: N/A.

* **Departure on 29 followed by an Arrival to 11:**
  VFR-1 & VFR-2: When a departure on 29 starts its roll, an arrival to 11 must be 15 NM from threshold. **(Updated by Tracon on 8/28/97.)**
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  D/A separation: VFR-1 & VFR-2: 15 NM. IFR1: N/A.

Dependencies Between 4R (or 4L) & 11/29 – NE Flow – Calibration

* **Arrivals to 11 are allowed to land and hold short of 4R and 4L:**
  Therefore, arrivals to 11 are independent of arrivals and departures on 4R and 4L.
  Dependencies: N/A.

* **Departures on 29 use the intersection at Taxiway R.**
  Therefore, departures on 29 are independent of all arrivals and departures on 4R and 4L.
  Dependencies: N/A.

Dependencies Between 22R (or 22L) & 11/29 – SW Flow – Calibration

* **Arrivals to 11 are allowed to land and hold short of 22R and 22L:**
  Therefore, arrivals to 11 are independent of arrivals and departures on 22R and 22L.
  Dependencies: N/A.

* **Departures on 29 use the intersection at Taxiway R.**
  Therefore departures on 29 are independent of all arrivals and departures on 22R/ 22L.
  Dependencies: N/A.

NOTE: **There are no dependencies associated with Arrivals on 29 or Departures on 11 because the Design Team agreed that these operations would not be simulated.**

EXHIBIT 3 - EWR HOUR COUNTS

HOUR COUNTS -- 1996 DEMAND (SCD-454)

LOCAL HOUR	ARRIVALS HOUR COUNTS			DEPARTURES HOUR COUNTS			TOTAL HOUR COUNTS		
	AC	GA/MI	TOTAL	AC	GA/MI	TOTAL	AC	GA/MI	TOTAL
0	18	3	21	0	1	1	18	4	22
1	4	1	5	3	1	4	7	2	9
2	1	0	1	0	1	1	1	1	2
3	4	0	4	14	0	14	18	0	18
4	3	0	3	7	0	7	10	0	10
5	10	0	10	4	0	4	14	0	14
6	10	3	13	20	2	22	30	5	35
7	20	2	22	48	1	49	68	3	71
8	56	3	59	60	1	61	116	4	120
9	17	6	23	62	0	62	79	6	85
10	15	3	18	18	3	21	33	6	39
11	57	2	59	18	1	19	75	3	78
12	29	1	30	60	2	62	89	3	92
13	44	0	44	21	2	23	65	2	67
14	42	0	42	47	1	48	89	1	90
15	47	0	47	46	4	50	93	4	97
16	60	2	62	46	2	48	106	4	110
17	33	1	34	59	2	61	92	3	95
18	70	0	70	37	0	37	107	0	107
19	35	1	36	60	4	64	95	5	100
20	40	1	41	36	0	36	76	1	77
21	30	2	32	12	3	15	42	5	47
22	24	1	25	8	0	8	32	1	33
23	25	0	25	8	1	9	33	1	34
	694	32	726	694	32	726	1388	64	1452

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

AC -- **OAG counts were supplemented to get AC counts.**
OAG counts included Federal Express counts.
Federal Express supplied their schedules for 8/22/96.

GA/MI -- **They were based on the hourly EWR Tower counts for 8/22/96.**

EXHIBIT 3 - EWR HOUR COUNTS (Cont.)

HOUR COUNTS -- FUTURE 1 DEMAND (SCD-500)

LOCAL HOUR	ARRIVALS HOUR COUNTS			DEPARTURES HOUR COUNTS			TOTAL HOUR COUNTS		
	AC	GA/MI	TOTAL	AC	GA/MI	TOTAL	AC	GA/MI	TOTAL
0	20	3	23	0	1	1	20	4	24
1	4	1	5	3	1	4	7	2	9
2	1	0	1	0	1	1	1	1	2
3	4	0	4	15	0	15	19	0	19
4	3	0	3	8	0	8	11	0	11
5	11	0	11	4	0	4	15	0	15
6	11	3	14	22	2	24	33	5	38
7	22	2	24	53	1	54	75	3	78
8	62	3	65	66	1	67	128	4	132
9	19	6	25	69	0	69	88	6	94
10	18	3	21	20	3	23	38	6	44
11	63	2	65	20	1	21	83	3	86
12	32	1	33	66	2	68	98	3	101
13	49	0	49	23	2	25	72	2	74
14	46	0	46	52	1	53	98	1	99
15	52	0	52	51	4	55	103	4	107
16	66	2	68	51	2	53	117	4	121
17	36	1	37	65	2	67	101	3	104
18	77	0	77	41	0	41	118	0	118
19	39	1	40	66	4	70	105	5	110
20	44	1	45	40	0	40	84	1	85
21	33	2	35	13	3	16	46	5	51
22	27	1	28	9	0	9	36	1	37
23	28	0	28	9	1	10	37	1	38
	767	32	799	766	32	798	1533	64	1597

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

AC -- Future 1 AC hour counts are 10.4% higher than 1996 AC hour counts.

GA/MI -- GA/MI hour counts are the same at all 3 demand levels.

EXHIBIT 3 - EWR HOUR COUNTS (Cont.)

HOUR COUNTS – FUTURE 2 DEMAND (SCD-550)

LOCAL HOUR	ARRIVALS HOUR COUNTS			DEPARTURES HOUR COUNTS			TOTAL HOUR COUNTS		
	AC	GA/MI	TOTAL	AC	GA/MI	TOTAL	AC	GA/MI	TOTAL
0	22	3	25	0	1	1	22	4	26
1	4	1	5	3	1	4	7	2	9
2	1	0	1	0	1	1	1	1	2
3	4	0	4	17	0	17	21	0	21
4	3	0	3	9	0	9	12	0	12
5	12	0	12	5	0	5	17	0	17
6	12	3	15	24	2	26	36	5	41
7	24	2	26	59	1	60	83	3	86
8	68	3	71	73	1	74	141	4	145
9	22	6	28	76	0	76	98	6	104
10	21	3	24	22	3	25	43	6	49
11	70	2	72	22	1	23	92	3	95
12	35	1	36	73	2	75	108	3	111
13	54	0	54	25	2	27	79	2	81
14	51	0	51	57	1	58	108	1	109
15	57	0	57	56	4	60	113	4	117
16	73	2	75	56	2	58	129	4	133
17	40	1	41	72	2	74	112	3	115
18	85	0	85	45	0	45	130	0	130
19	43	1	44	73	4	77	116	5	121
20	49	1	50	44	0	44	93	1	94
21	36	2	38	15	3	18	51	5	56
22	30	1	31	10	0	10	40	1	41
23	31	0	31	10	1	11	41	1	42
	847	32	879	846	32	878	1693	64	1757

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

AC – Future 2 AC hour counts are 10.4% higher than the Future 1 AC hour counts.

GA/MI – GA/MI hour counts are the same at all 3 demand levels.

EXHIBIT 4 - EWR HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS

LOCAL HOUR	SCD-454 (1996) HOUR COUNTS			SCD-500 (FUTURE 1) HOUR COUNTS			SCD-550 (FUTURE 2) HOUR COUNTS		
	ARR	DEP	TOTAL	ARR	DEP	TOTAL	ARR	DEP	TOTAL
0	21	1	22	23	1	24	25	1	26
1	5	4	9	5	4	9	5	4	9
2	1	1	2	1	1	2	1	1	2
3	4	14	18	4	15	19	4	17	21
4	3	7	10	3	8	11	3	9	12
5	10	4	14	11	4	15	12	5	17
6	13	22	35	14	24	38	15	26	41
7	22	49	71	24	54	78	26	60	86
8	**59**	**61**	**120 ***	**65**	**67**	**132 ***	**71**	**74**	**145 ***
9	23	62	85	25	69	94	28	76	104 *
10	18	21	39	21	23	44	24	25	49
11	59	19	78	65	21	86	72	23	95
12	30	62	92	33	68	101 *	36	75	111 *
13	44	23	67	49	25	74	54	27	81
14	42	48	90	46	53	99	51	58	109 *
15	47	50	97	52	55	107 *	57	60	117 *
16	62	48	110 *	68	53	121 *	75	58	133 *
17	34	61	95	37	67	104 *	41	74	115 *
18	70	37	107 *	77	41	118 *	85	45	130 *
19	36	64	100 *	40	70	110 *	44	77	121 *
20	41	36	77	45	40	85	50	44	94
21	32	15	47	35	16	51	38	18	56
22	25	8	33	28	9	37	31	10	41
23	25	9	34	28	10	38	31	11	42
	726	726	1452	799	798	1597	879	878	1757

NOTES: **Counts include AC (Air Carrier/Commuter/Air Taxi), GA, and MI.**

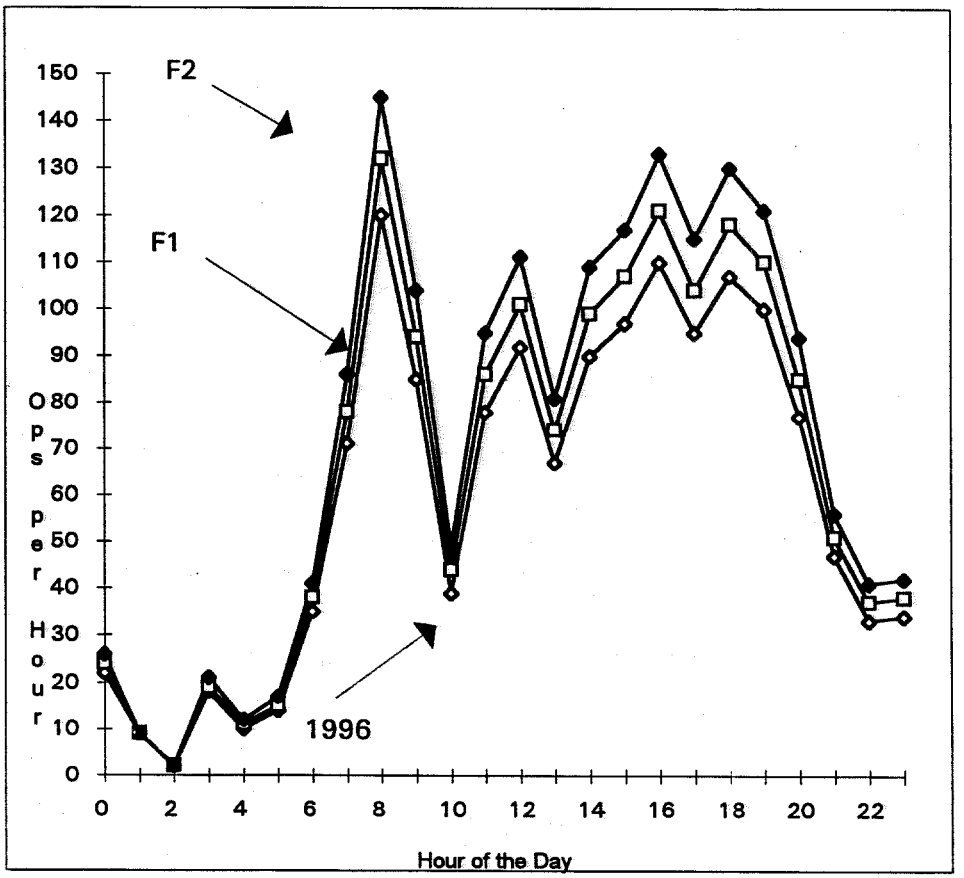
1996 -- **Highest hour count is 120 -- at 8am.**
4 hours have counts of at least 100. See *.
Between 3pm and 8pm, the number of hourly ops ranges from 95 to 110.

Future 1 -- **Highest hour count is 132 -- at 8am.**
7 hours have counts of at least 100. See *.
Between 3pm and 8pm, the number of hourly ops ranges from 104 to 121.

Future 2 -- **Highest hour count is 145 -- at 8am.**
9 hours have counts of at least 100. See *.
Between 3pm and 8pm, the number of hourly ops ranges from 115 to 133.

EXHIBIT 4 - EWR HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS (Cont.)

HOUR	1996	F1	F2
0	22	24	26
1	9	9	9
2	2	2	2
3	18	19	21
4	10	11	12
5	14	15	17
6	35	38	41
7	71	78	86
8	120	132	145
9	85	94	104
10	39	44	49
11	78	86	95
12	92	101	111
13	67	74	81
14	90	99	109
15	97	107	117
16	110	121	133
17	95	104	115
18	107	118	130
19	100	110	121
20	77	85	94
21	47	51	56
22	33	37	41
23	34	38	42
	1452	1597	1757



NOTES: **AC –** **Future 1 AC hour counts are 10.4% higher than 1996 AC hour counts.**
Future 2 AC hour counts are 10.4% higher than the Future 1 AC hour counts.

GA/MI – **GA/MI hour counts are the same at all 3 demand levels.**

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA/MI maintain their own peaking characteristics.

EXHIBIT 5 - WEATHER CATEGORIES AND MINIMA

(Operational Procedures and Minima -- EWR CALIBRATION)

(Revised on 10/2/97)

VFR-1: **77.5 %**
Ceiling $\geq$ 3,500' *and* Visibility $\geq$ 5 miles.
Visual (VFR-1) separations for A/A, A/D, and D/A.
Radar (IFR1) separations for D/D on all runways.
LARGE COMMUTERS (and smaller aircraft) depart 29 at Intersection Romeo.
Regional Jets cannot depart at Intersection Romeo. They depart on 4/22.
Simultaneous approaches to 11 and either 4R or 4L.
Simultaneous approaches to 11 and either 22R or 22L (with LAHSO).

VFR-2: **14.2 %**
Less than VFR-1, *and*, Ceiling $\geq$ 1,000' *and* Visibility $\geq$ 3 miles.
Radar (IFR) separations for A/A & D/D on all runways.
Visual (VFR1) separations for A/D & D/A.
Simultaneous approaches to 11 and either 4R or 4L.
Simultaneous approaches to 11 and either 22R or 22L (with LAHSO).

IFR-1a: **4.1 %**
Less than VFR-2, *and*, Ceiling $\geq$ 600' *and* Visibility $\geq$ 2 miles.
These are the CAT I minima for Runway 11. Currently, there are no arrivals on 11 in IFR-1a.
IFR separations.

IFR-1b: **<4.2 %**
Less than IFR-1a, *and*, Ceiling $\geq$ 200' *and* Visibility $\geq$ 3/8 miles.
What percent of the time is EWR *below* IFR-1a (CAT I minima for 11) and *above* CAT I minima for 4/22s?
IFR separations.

IFR-2: **? %**
Less than IFR-1b. Weather is CAT II or below.
What percent of the time is EWR *below* IFR-1b (CAT I minima for 4/22s)?
IFR separations.

Note:			
	CAT I ILS:	Runway 11:	Minima are 604' & 2 miles.
	CAT I ILS:	Runways 4s & 22s :	Minima are 200' and 3/8 mile.
	CAT II ILS:	Runway 4R:	Minima are 162'/16'.

Notes: ***For simulation purposes, CAT II is similar to CAT I in IFR-1b, with one exception -- there is only one CAT II arrival runway. Simulating IFR-1b captures most of the annual delays associated with CAT II. None of the improvements affect CAT II. The Technical Center recommends simulating IFR-1b 4.2% of the year and not simulating IFR-2. The 1995 Study utilized the same technique.***

At the June meeting, the Design Team stated CRDA is available but would not be used until 1998.

Source of weather categories, minimums, and percent occurrence: Based on EWR Study, 1995.

EXHIBIT 6 - WEATHER CATEGORIES & CONFIGURATIONS (Observed)

(REVISED 10/3/97)

The following data represent the daytime runway use, by weather category, based on the 1995 EWR study. It was based on 12 years of *observed* data.

EXISTING DAYTIME RUNWAY USE BY WEATHER CATEGORY (based on 1995 EWR Study)

		VFR-1	VFR-2	IFR-1a	≤IFR-1b	TOTAL
4, 11, 29	(winds **permit** LAHSOs on 11)	16.5%	5.8%	2.2%	2.3%	26.8%
4, 11, 29	(winds **prevent** LAHSOs on 11)	8.4%	0.6%	0.1%	0.0%	9.1%
4, 29	(winds **prevent** use of 11)	5.3%	0.2%	0.0%	0.0%	5.5%
	NE Flow Subtotal	**30.2%**	**6.6%**	**2.3%**	**2.3%**	**41.4%**
22, 11, 29	(winds **permit** LAHSOs on 11)	21.3%	4.3%	1.2%	1.3%	28.1%
22, 11, 29	(winds **prevent** LAHSOs on 11)	15.1%	2.0%	0.4%	0.3%	17.8%
22, 29	(winds **prevent** use of 11)	8.1%	0.8%	0.1%	0.1%	9.1%
	SW Flow Subtotal	**44.5%**	**7.1%**	**1.7%**	**1.7%**	**55.0%**
4 only or 22 only		1.9%	0.4%	0.1%	0.2%	2.6%
11 only or 29 only		0.9%	0.1%	0.0%	0.0%	1.0%
	TOTAL	**77.5%**	**14.2%**	**4.1%**	**4.2%**	**100.0%**

Notes:

1. Runway use percentages were based on the following wind component restrictions:

	Max Crosswind	Max Tailwind
4 & 22	20 knots	Calm
11 with LAHSO	15 knots	**Calm (See note 5)**
11 & 29 without LAHSO	15 knots	10 knots

2. Use of 11 & 29 restricted to LC/MED/SM aircraft when 4 or 22 were available for use.
3. Daytime hours are 6am to 11pm.
4. Winds prevent use of 29 approximately 1.5% of the year. Because of its small percent of occurrence, this configuration was not modeled explicitly in the 1995 study.
5. **On 8/28/97, Design Team revised Max Tailwind to "Calm" for 11 with LAHSO.**
6. **Design Team will try to reconfirm percentages of occurrence of 11 with LAHSO.**
7. **Design Team will try to determine percentage of occurrence of IFR-2.**

Source of weather categories, minimums, and percent occurrence: Based on EWR Study, 1995. The percentages were developed by Leigh Fisher Associates (LFA) for the 1995 Study. LFA tabulated the hourly weather data for January 1, 1981, through December 31, 1993, from the National Climatic Data Center, Asheville, North Carolina. The tabulations reflect percent of occurrence during daytime hours, 6am to 11pm.

EXHIBIT 7 - WEATHER CATEGORIES & CONFIGURATIONS (Simulated)

(REVISED 10/14/97)

The following table represents the way the weather categories and configurations can be simulated. It forms the basis for the EWR ADSIM experimental design, reflects the way Calibration or an improvement is simulated, and shows how delays are annualized.

This table was developed from the observed data. The Technical Center combined some conditions to capture critical delays and delay savings, while reducing the number of simulations.

How does EWR operate in the NE flow in VFR-1, when the winds do not permit LAHSOs on 11? Is Runway 11 used for arrivals, which are dependent on departures on 4s? Or, do the arrivals land on the parallels?

		VFR-1	VFR-2	IFR-1a	≤IFR-1b	TOTAL
4, 11, 29	winds ***permit*** use of 11	25.8%	6.8%	2.4%	2.4%	37.4%
4, 29	winds ***prevent*** use of 11	5.5%	-----	-----	-----	5.5%
	NE Flow Subtotal	**31.3%**	**6.8%**	**2.4%**	**2.4%**	**42.9%**
22, 11, 29	winds ***permit*** use of 11	22.1%	4.5%	1.8%	1.8%	30.1%
22, 29	winds ***prevent*** use of 11	24.1%	2.9%	-----	-----	27.0%
	SW Flow Subtotal	**46.2%**	**7.4%**	**1.8%**	**1.8%**	**57.1%**
	TOTAL	**77.5%**	**14.2%**	**4.1%**	**4.1%**	**100.0%**

Notes:
NE Flow: VFR-1 combines the use of 11, with & without LAHSO.
NE Flow: VFR-2, IFR-1a, IFR-1b assume winds always permit use of 11.
NE Flow: DCIA affects only IFR-1a (down to RWY 11 minima) and only in NE Flow.
SW Flow: VFR-1, VFR-2 combines "without 11" & without LAHSO.
SW Flow: IFR-1a, IFR-1b assume winds always permit use of 11.
SW Flow: SCIA affects only IFR-1a (down to RWY 11 minima) and only in SW Flow.
Assumes LAHSO permitted when 11 is used.
The percentages were normalized so they sum to 100%.
Captures critical delays and delay savings, while reducing unnecessary simulations.

EXHIBIT 8 - EWR EXPERIMENTAL DESIGN -- 1996 DEMAND

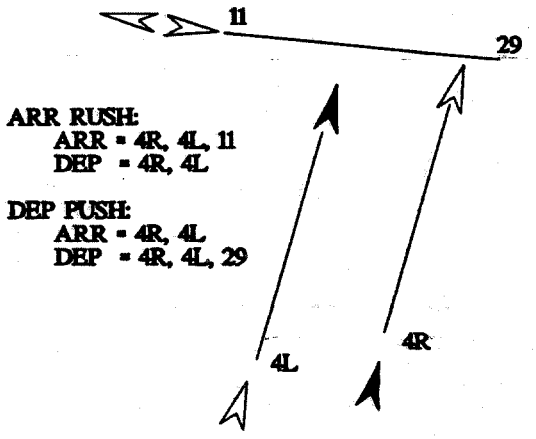
(Revised 10/23/97)

		NE FLOW						SW FLOW						
		ARR = 4R, 4L, (11) DEP = 4R, 4L, 29						ARR = 22L, 22R, (11) DEP = 22L, 22R, 29						
PKG	1996 DEMAND 454,000 ANNUAL OPS	VFR-1 with 11 25.8%	VFR-1 w/o 11 5.5%	VFR-2 with 11 6.8%	VFR-2 w/o 11 -----	IFR-1a 2.4%	IFR-1b 2.4%	VFR-1 with 11 22.1%	VFR-1 w/o 11 24.1%	VFR-2 with 11 4.5%	VFR-2 w/o 11 2.9%	IFR-1a 1.8%	IFR-1b 1.8%	
(0)	Calibration													
(A)	New Do-Nothing Base-Case (with DCIA)	= (0) Calibration in VFR & IFR -- NE Flow						= (0) Calibrat. in VFR--SW Flow					=(0)	affects IFR-1a
(B)	Taxiway System Imp (B1) Alt. Depart Que-4L/22R (B2) Added Access to 11/29 (B3) Off-Gate Holding Area													
(C)	LDA Offset (C1) LDA Offset to 4s (C2) LDA Offset to 22s	=(0) =(0)	=(0) =(0)	=(0) =(0)	=(0) =(0)	 =(0)	 =(0)	=(0) =(0)	=(0) =(0)	=(0) =(0)	=(0) =(0)	=(0)	=(0)	affects NE Flow affects SW Flow
(D)	Parallel Simult. Vis. App.			=(0)	=(0)	=(0)	=(0)			=(0)	=(0)	=(0)	=(0)	affects VFR-1
(E)	SCIA	= (0) Calibrat. in VFR--NE Flow					=(0)	= (0) Calibration in VFR & IFR -- SW Flow						affects IFR-1a
(F)	Reduced Min. Sep.--2 NM	=(0)	=(0)					=(0)	=(0)					affects VFR-2, IFR-1

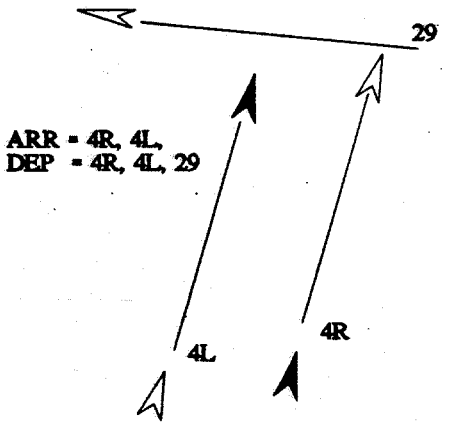
NOTE: =(0): Results equal those of Improvement PKG (0), Calibration, for that Weather Condition and Flow Direction.

EXHIBIT 9 - RUNWAY CONFIGURATIONS (EWR CALIBRATION)

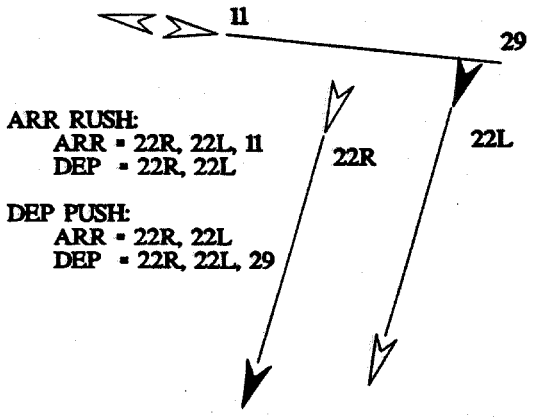
NE – VFR1 & VFR2



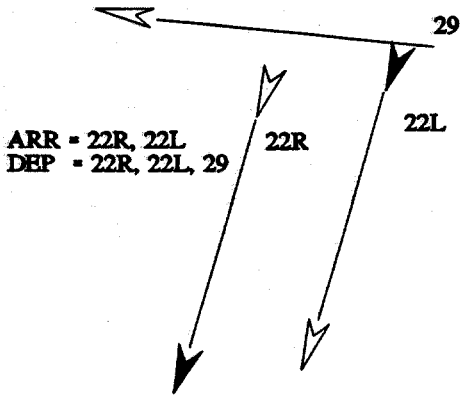
NE – IFR1



SW – VFR1 & VFR2



SW – IFR1



◄ = PRIMARY ARR OR DEP RUNWAY

Filename: T:\AIRPORTS\EWR\DP4\CON-EWR4.GED
Modified IFR1 on 7/10/97 -- Departures on 29. No Arrivals on 11.
CONFIG 1 = NE FLOW
CONFIG 2 = SW FLOW

2. NEWARK CAPACITY ANALYSIS

The FAA Technical Center uses a form of the RDSIM simulation model to compute an airport's capacity. In this model, the airport is presented with a one-hour schedule of uniformly distributed operations at ever increasing levels of demand. The proportion of arrivals and departures in this schedule can be specified to simulate different percentages of arrival and departure demand. The critical inputs to the capacity analysis are: fleet mix, runway usage, aircraft separations, runway dependencies, lengths of common approach, approach speeds, exit probabilities, and runway occupancy times.

The model computes the *flow rate* as the number of operations serviced during a one-hour period and the average delay incurred by those aircraft.

The Technical Center performed a capacity analysis, while maintaining the airport's fleet mix. An arrival priority was used as long as a 50-50 flow rate (50% arrivals and 50% departures) was maintained. If the arrival priority reduced the departure flow rate, the model inserted a departure between two arrivals in order to achieve a balanced flow.

Capacities are shown for balanced flow rates (50% arrivals and 50% departures) and, when applicable, excess arrival or departure capacity. Excess arrival capacity represents an unbalanced flow rate which has more than 50% arrivals. Similarly, excess departure capacity represents an unbalanced flow rate which has more than 50% departures.

Exhibit 10 presents capacity curves (flow rates versus average delay per operation) for Newark *for the parallel runways – arrivals on 4R (or 22L) and departures on 4L (or 22R).* The capacity curves were developed for the existing airport using the 1996 fleet mix. The curves show the 4-minute average arrival/departure delay capacities and the maximum throughput capacities. Maximum throughput capacities are theoretical because they are usually associated with very high delays. The 4-minute average arrival/departure delay capacity was considered by other Design Teams to be a more practical capacity.

In VFR-1, the curve for *balanced flows* indicates the parallel runways have an hourly capacity of 72 operations (36 arrivals and 36 departures) with a 4-Minute Average Delay. The maximum throughput capacity of 78 operations (39 arrivals and 39 departures) is associated with much higher average delays. For an increase of 6 operations per hour, the average delay increases by 14 minutes (from 4 minutes to 18 minutes).

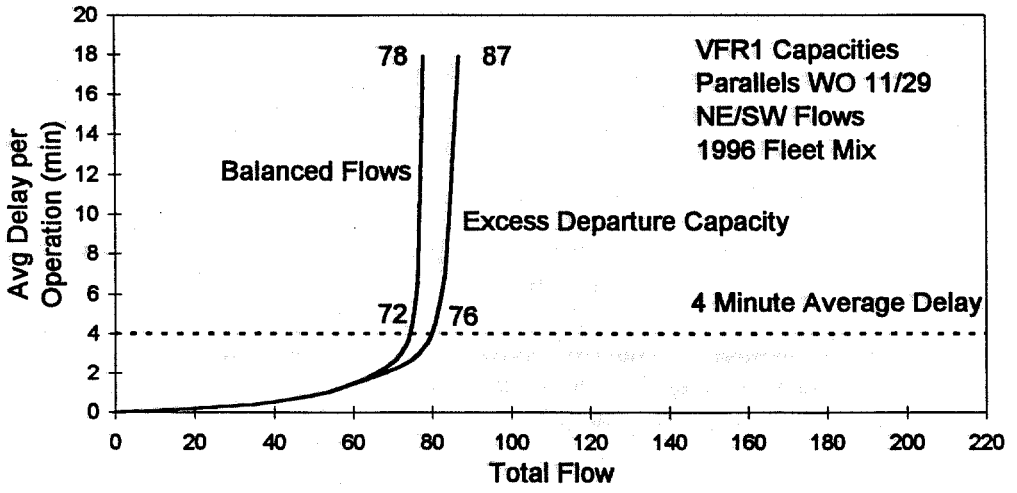
In VFR-1, the curve for *excess departure capacity* indicates the parallel runways have an hourly capacity of 76 operations (36 arrivals and 40 departures) with a 4-Minute Average Delay. The maximum throughput capacity of 87 operations (39 arrivals and 48 departures) is associated with much higher average delays. For an increase of 9 operations per hour, the average delay increases by 14 minutes (from 4 minutes to 18 minutes).

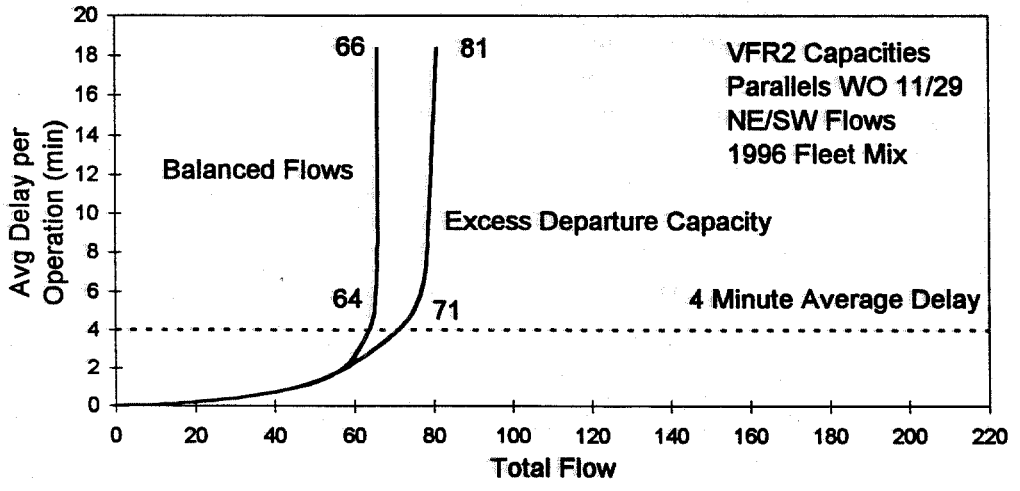
The *excess departure capacity* in VFR-1 means EWR can handle more departures than arrivals – 4 more departures per hour with a 4-minute average delay and 9 more departures per hour at the maximum throughput capacity.

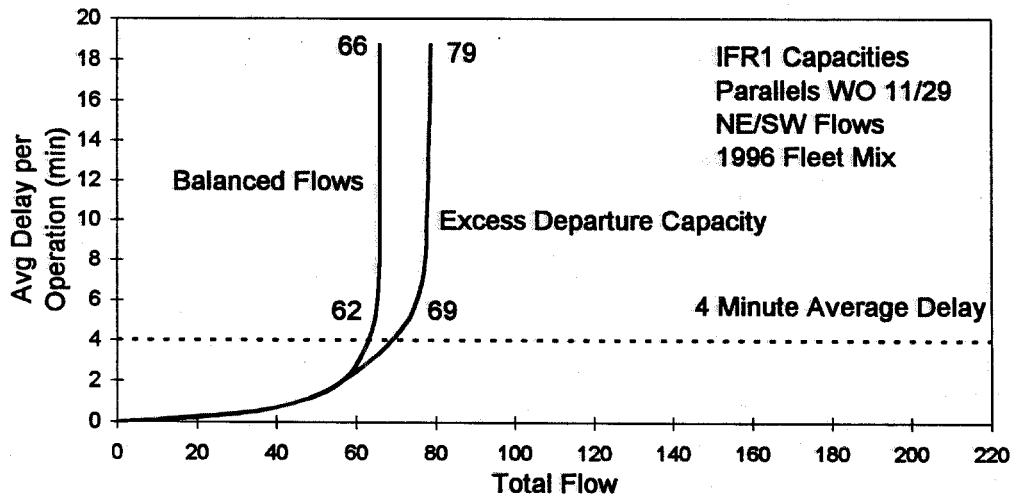
One can interpret the curves for VFR-2 and IFR-1 in a similar fashion. With a 4-minute average delay and balanced flows, the VFR-2 capacity is 64 and the IFR-1 capacity is 62.

EXHIBIT 10 - PRELIMINARY CAPACITY ANALYSIS -- EWR

(EWR Existing Airport -- Current Fleet Mix -- 50/50 Split -- Parallels WO 11/29)







3. POTENTIAL IMPROVEMENTS AND AIRPORT DIAGRAM

Exhibit 11 summarizes proposed improvements for the Airport Capacity Enhancement Design Team Study. The potential improvements are grouped as follows:

- Airfield
- Facilities and Equipment
- Operations
- User and Policy

The proposals for this Design Team study require detailed analysis of runways, taxiways, and gates. The Airfield Delay Simulation Model (ADSIM) will be used for simulating the Newark International Airport.

Exhibit 12 lists simulation scenarios for Newark.

Exhibit 13 presents a diagram of the existing airport.

The Experimental Design will consist of three demand levels (daily aircraft schedules). The runway configurations and traffic distributions may change for each demand level dependent upon the time frame of the runway extension efforts.

The Experimental Design normally includes runs for VFR and IFR conditions and for operations in both directions on each runway. The Design Team may decide that some of these runs can be eliminated if, for example, analysis of NE and SW runway operations produce nearly equivalent results. Combining improvements into logical packages may also help reduce the required experiments to a manageable number.

EXHIBIT 11 - POTENTIAL IMPROVEMENTS

(Revised on 9/30/97)

AIRFIELD IMPROVEMENTS — PROPOSED MODEL

- **Taxiway System Improvements (Exits, Queuing, Hold Blocks, etc.).**
  - Alternative departure queue schemes for extended Runway 4L/22R.
  - Additional access to Runway 11/29 (between Y and RM) across drainage ditch.
  - Off-gate holding areas in addition to BALL PARK.

FACILITIES AND EQUIPMENT IMPROVEMENTS

- **LDA 24° Offset Approach**
  - **-- to inboard runway (4L or 22R) by non-heavy aircraft & commuters.**
  - Allows parallel arrival streams during arrival peaks in less than VFR1 weather (i.e., down to 2,000' or 3,000' ceiling) in NE and SW flows.
  - **Can a 757 do an LDA approach?**
  - LDA offset to 4s does not affect Teterboro operations.
  - LDA offset to 22s affects Teterboro operations (arrivals to Runway 6) and reduces its capacity.
  - Perform capacity analysis to determine adverse impact on Teterboro arrival capacity.

OPERATIONAL IMPROVEMENTS

- **Parallel Simultaneous Visual Approaches (using wake vortex technology).**
  - LDA may aid this operation.
- **SCIA -- Simultaneous Converging Instrument Approaches.**
  - In VFR2 & IFR1 -- permits simultaneous approaches to 11 and either 22R or 22L.
  - Down to IFR1 minimums using FMS (which reduces TERPS criteria).
  - Down to IFR1 minimums using GPS.
- **DCIA -- Dependent Converging Instrument Approaches.**
  - Possible improvement in 1998.
  - Look at ground movement alternatives for arrivals to 11 and 4R, and departures to 22L.
  - DCIA requires CRDA (Converging Runway Display Aid) and ASR-9.
  - In VFR2 -- permits simultaneous approaches to 11 and either 22R or 22L .
  - In IFR1 -- permits dependent approaches to 11 and either 22R or 22L.
  - Enables departures on 22s to be released more efficiently between successive arrivals on 11?
  - In SW flow, reduces the A/A separations on 11 (to 6 NM from 10NM) when landing on 22s.
- **Reduce Minimum In-Trail IFR Separation to 2.0 NM -- between similar class non-heavy aircraft.**

USER OR POLICY ALTERNATIVES

Notes: Wait for simulation results for longer term strategic type of alternatives:

- **Effect of fleet mix changes on EWR capacity and/or delay.**
- **Schedule or banking changes, such as more uniform distribution of traffic.**
- **Segregation of commuters.**
- **Gate sharing.**
- **Tilt rotor aircraft.**
- **Minimum size aircraft.**

EXHIBIT 12 - SIMULATION SCENARIOS (EWR)

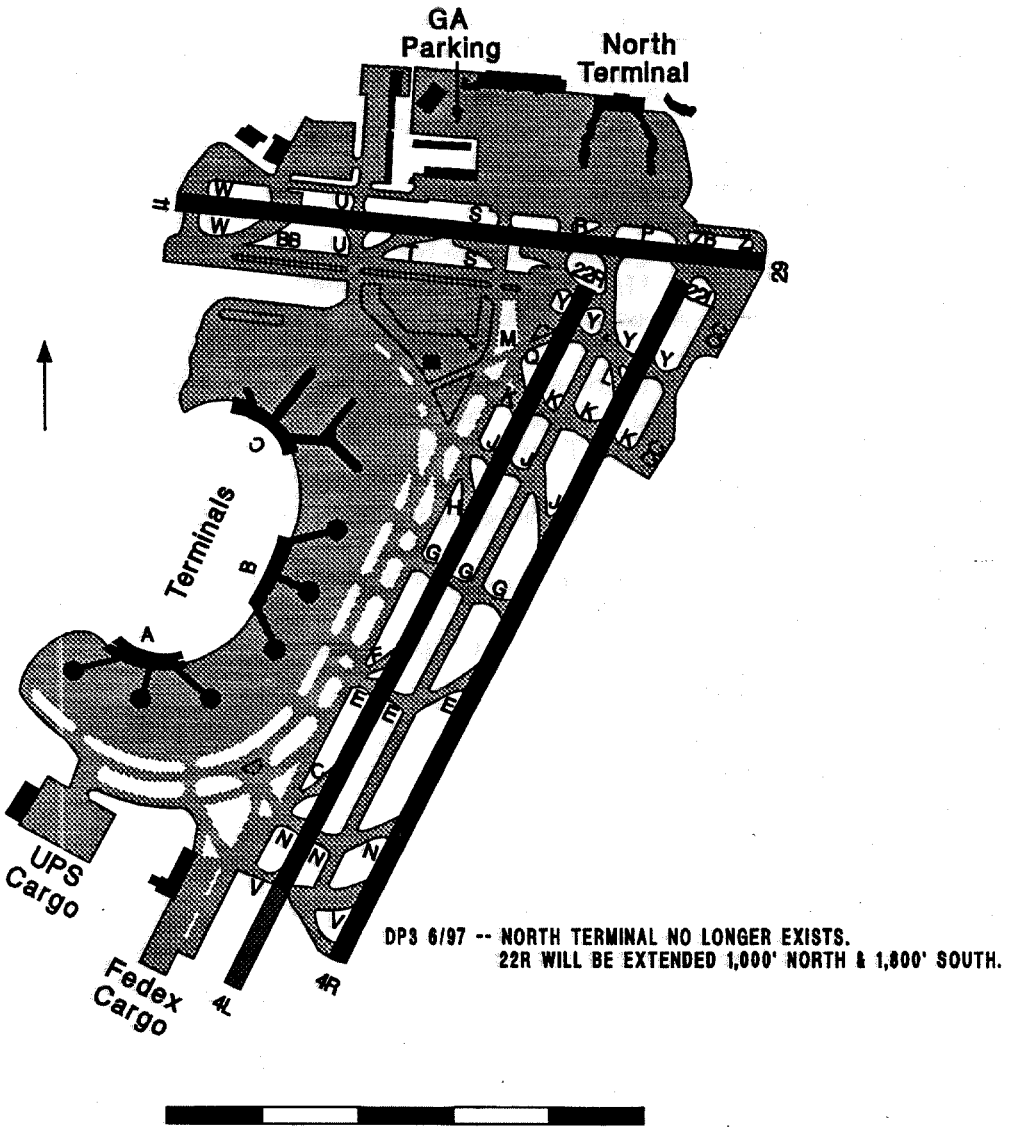
PKG	DESCRIPTION OF PACKAGE	SIMULATE AT THESE DEMAND LEVELS 1996	F1	F2
(0)	**CALIBRATION (with 2.5 NM minimum IFR spacing)**	Y	N	N
(A)	**NEW DO-NOTHING (with DCIA) -- BASE-CASE** With Dependent Converging Instrument Approaches expected in 1998.	Y	Y	Y
(B)	**Taxiway System Improvements** Exits, Queuing, Hold Blocks, etc.			
	(B1) Alternate Departure Queuing Scheme for Extended 4L/22R	Y	Y	Y
	(B2) Additional Access to 11/29 across Drainage Ditch	Y	Y	Y
	(B3) Off-Gate Holding Areas in Addition to BALL PARK	Y	Y	Y
(C)	**LDA 24° Offset Approach to Inboard Runway by Non-Heavy Aircraft**			
	(C1) LDA Offset to 4s (does not affect Teterboro ops)	Y	Y	Y
	(C2) LDA Offset to 22s (affects Teterboro ops)	Y	Y	Y
(D)	**Parallel Simultaneous Visual Approaches (using Wake Vortex Technology)**	Y	Y	Y
(E)	**SCIA -- Simultaneous Converging Instrument Approaches**	Y	Y	Y
(F)	**Reduce Minimum In-Trail IFR Separation to 2.0 NM** (Between similar class non-heavy aircraft)	Y	Y	Y

Notes: **Y (N) -- Do (Do Not) Simulate at this demand level.**

The DCIA could be simulated as part of the New Do-Nothing Case (BASE-CASE) at EWR. Since it will be in place in 1998, does the Design Team want to do this? If so, the DCIA could become the New Do-Nothing Case used to compute the savings of all other improvements?

Similarly, should SCIA be considered part of the New Do-Nothing Case (BASE-CASE) at EWR?

EXHIBIT 13 - AIRPORT DIAGRAM (EWR)



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4. DESIGN TEAM SCHEDULE

Exhibit 14 lists the meetings concerning the completion of significant tasks, outputs, and target dates of the EWR Design Team schedule. These milestones and meetings will be held at key decision points, and will help the Design Team monitor the progress of the study.

EXHIBIT 14 - DESIGN TEAM SCHEDULE

Date	Event	Objective	Task	Responsibility	Output
11/18/96	1.	Kick Off Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Technical Plan, & Potential Improvements. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements. Review & Agree on Purpose and Inputs.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
12/9/96 thru 12/13/96	2.	Perform Data Collection.	On-Site Data Collection.	Tech Center.	Establish Parameters for Analysis.
1/14 /97	3.	Determine Scope of Study, Select Model. Review Results of Data Collection.	Review Results. Review Data Package 1.	Entire Design Team.	Agree on Inputs & Direction.
4/10/97	4.	Review Results of Data Collection, Model Inputs, & Potential Improvements.	Review Data Package 2.	Entire Design Team.	Agree on Inputs & Direction.
6/18/97	5.	Review Model Inputs & Potential Improvements.	Review Data Package 3 .	Entire Design Team.	Agree on Inputs & Direction.
8/28/97	5.	Review Inputs, Improvements, & Capacity Analysis.	Review Data Package 4 .	Entire Design Team.	Agree on Inputs, Direction, & Results.
10/29/97	5.	Review Inputs, Improvements, & ADSIM Calibration.	Review Data Package 5 .	Entire Design Team.	Agree on Inputs, Direction, & Results.
/ /	7.	□ □ □			
/ /98	?.	Complete & Publish Final Report.	Publish & Distribute Final Report.	FAA HQ.	Final Report.

* Number of meetings and target dates are tentative and may be adjusted as progress is achieved.

APPENDIX A

ACCEPTED MODEL INPUTS

AIRCRAFT CLASSIFICATIONS

Accepted by EWR Team on 4/10/97.
BA41 reclassified as LC – Revised on 7/31/97.

H	**= HEAVY**	**Heavy aircraft.** Heavy aircraft weighing more than 255,000 pounds (e.g., L1011, DC10, B747, B767, DC8S, A300).
757	**= 757**	**B757.** B757 only.
LJ	**= LARGE JET**	**Large jets.** Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., DC9, B737, B727, MD80).
LC	**= LARGE COMMUTER**	**Large Commuters. Includes Small Regional Jets.** Large commuter aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., ATR-42*, DH8, DH7, CRJ, BA41*, SF34*).
M	**= MEDIUM**	**Small Commuters. Includes Business Jets.** Small commuter aircraft weighing more than 12,500 and less than 41,000 pounds (e.g., BA31, BE02, E120, LR31, LR36).
S	**= SMALL**	**Small twin & single engine props.** Small, single or twin engine aircraft weighing 12,500 pounds or less (e.g. BE58, BE90, C340, C441, AC21, BE20, C172, C210, DO27).

Notes:

Aircraft Classifications were agreed upon by Design Team at 4/10/97 meeting. They agreed to include Small Regional Jets in Class LC. At the Design Team's request, the Technical Center modified the list of aircraft types in Class LJ to include reflect the types of aircraft operating at EWR. For wake turbulence application, FAA Handbook 7110.65 considers LJ & LC as "large" and M & S as "small".

These aircraft classes will enable us to define the model inputs more accurately and more clearly by distinguishing the key differences in operational characteristics. Class names, rather than class numbers, will be used in the data packages. The following describes the new class names which will be used in the study and the class numbers used in previous documents.

HEAVY:	(old Class 1 in Data Pkg. 1)
757:	(old Class 2 in Data Pkg. 1)
LARGE JET:	(old Class 3 in Data Pkg. 1)
LARGE COMMUTER:	(old Class 3 in Data Pkg. 1)
MEDIUM:	(old Class 4 in Data Pkg. 1)
SMALL:	(old Class 5 & 6 in Data Pkg. 1)

The critical factor in determining aircraft class should be approach speeds and how arrivals are separated at the point of closest approach (at threshold, except for a "small" following a "heavy").

*The aircraft ATR-42 and SF34 are exempt from the small category and are classified as large aircraft for separation purposes. (Source: FAA memo from ANM-531.4). They are classified as LARGE COMMUTER in this study. **July 1997, the Tower told the Technical Center to reclassify the BA41 as LC for this study.**

Weights refer to maximum certified takeoff weights.

RUNWAY EXIT DATA – 4R and 4L **Accepted by EWR Team on 6/28/97.**

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 4R

	Exit	G	J	K	L	Y	
	Distance	3600'	4400' hs	5900'	6450' hs	6750'	TOTAL
(H)	Utilization			42%	50%	8%	100%
	ROT			59	56	74	59 sec
	Count			5	6	1	12
(757)	Utilization		9%	56%	35%		100%
	ROT		34	60	56		56 sec
	Count		2	13	8		23
(LJ)	Utilization		17%	51%	31%	1%	100%
	ROT		33	54	52	71	50 sec
	Count		14	43	26	1	84
(LC)	Utilization	6%	69%		25%		100%
	ROT	36	35		56		40 sec
	Count	1	11		4		16
(M)	Utilization	7%	73%		20%		100%
	ROT	33	39		56		40 sec
	Count	1	11		3		15
(S)	Utilization	7%	93%				100 %
	ROT	36	40				40
	Count	E	E				E

Runway 4L

	Exit	G	H	J	K	O	M	Y	W	
	Distance	3600'	4500' hs	5150'	5950'	5950' hs	6750' rhs	6750'	7400'	TOTAL
(H)	Utilization					90%		10%		100%
	ROT					48		74		51 sec
	Count					E		E		E
(757)	Utilization		10%	20%		70%				100%
	ROT		35	50		48				47 sec
	Count		E	E		E				E
(LJ)	Utilization		25%	50%		25%				100%
	ROT		35	50		50				46 sec
	Count		1	3		E				E
(LC)	Utilization	6%	70%	24%						100%
	ROT	36	36	52						40 sec
	Count	E	1	E						E
(M)	Utilization	20%	65%	15%						100%
	ROT	36	39	52						40 sec
	Count	E	E	E						E
(S)	Utilization	50%	50%							100%
	ROT	36	40							38 sec
	Count	E	E							E

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

Estimated values for 4R/4L were generated by the FAA Technical Center and modified by the EWR Tower on 5/29/97.

RUNWAY EXIT DATA – 22R and 22L **Accepted by EWR Team on 6/28/97.**

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 22R

	Exit Distance	G 3400'	F 4600' hs	E 5000'	C 6350' hs	N 6950'	V 7700'	TOTAL
(H)	Utilization				90%	10%		100%
	ROT				50	74		52 sec
	Count				E	E		E
(757)	Utilization		10%		90%			100%
	ROT		42		48			47
	Count		E		E			E
(LJ)	Utilization	10%	20%		70%			100%
	ROT	36	40		49			46 sec
	Count	1	2		7			10
(LC)	Utilization		50%		50%			100%
	ROT		40		49			45 sec
	Count		E		E			E
(M)	Utilization		80%		20%			100%
	ROT		40		49			42 sec
	Count		E		E			E
(S)	Utilization		100%					100%
	ROT		38					38 sec
	Count		E					E

Runway 22L

	Exit Distance	G 3400'	E 4200' hs	N 6100' hs	V 7300' hs	TOTAL
(H)	Utilization			87%	13%	100%
	ROT			49	56	50 sec
	Count			13	2	15
(757)	Utilization		10%	90%		100%
	ROT		42	47		47 sec
	Count		3	28		31
(LJ)	Utilization		12%	85%	3%	100%
	ROT		34	44	53	43 sec
	Count		22	159	6	187
(LC)	Utilization	24%	56%	20%		100%
	ROT	36	32	45		36 sec
	Count	10	23	8		41
(M)	Utilization	2%	46%	52%		100%
	ROT	36	33	47		40 sec
	Count	1	20	23		44
(S)	Utilization		100%			100%
	ROT		35			35 sec
	Count		1			1

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

Estimated values for 22R/22L were generated by the FAA Technical Center and modified by the EWR Tower on 5/29/97.

RUNWAY EXIT DATA – 11 and 29 **Accepted by EWR Team on 8/28/97.**

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 11

	Exit Distance	S 3650'	R 4350'	P 4900'	ZA/ZB 5900'	Z 6600'	TOTAL
(H)	Utilization				60%	40%	100%
	ROT				56	64	59 sec
	Count				E	E	E
(757)	Utilization			30%	70%		100%
	ROT			48	56		54 sec
	Count			E	E		E
(LJ)	Utilization		10%	30%	60%		100%
	ROT		44	48	54		52 sec
	Count		E	E	E		E
(LC)	Utilization		100%				100%
	ROT		44				44 sec
	Count		1				1
(M)	Utilization	100%					100%
	ROT	43					43 sec
	Count	1					1
(S)	Utilization	100 %					100%
	ROT	43					43 sec
	Count	E					E

Runway 29

	Exit Distance	T 3700' hs	U 4550'	BB 5400'	W 6400'	TOTAL	
(H)	Utilization			60%	40%	100%	Revised (H)
	ROT			52	62	56 sec	on 7/15/97
	Count			E	E	E	
(757)	Utilization			60%	40%	100%	
	ROT			52	62	56 sec	
	Count			E	E	E	
(LJ)	Utilization		20%	60%	20%	100%	
	ROT		40	52	60	51 sec	
	Count		E	E	E	E	
(LC)	Utilization	100%				100%	
	ROT	37				37 sec	
	Count	13				13	
(M)	Utilization	100%				100%	
	ROT	39				39 sec	
	Count	4				4	
(S)	Utilization	100%				100%	
	ROT	39				39 sec	
	Count	E				E	

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

On 7/15/97, the Technical Center modified the values for Runway 29 based on the Tower's comment that most Heavies on Runway 29 take exit BB.

EWR VFR (VISUAL) SEPARATIONS

Accepted by EWR Team on 6/28/97.
D/D separations -- Revised on 8/28/97.

(In-trail Separations on Same Runway)

A/A (NM)*	*LEAD ARR*	*TRAIL ARR*---	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	3.99	4.88	5.06	5.06	5.99	6.42	
	757	*(7110.65--757)*	3.99	4.24	4.24	4.24	4.36	4.32	
	LJ	*(7110.65--Large)*	3.18	3.08	3.19	3.19	4.36	4.32	
	LC	*(7110.65--Large)*	3.18	3.08	3.19	3.19	4.36	4.32	
	MED	*(7110.65--Small)*	3.18	3.08	3.19	3.19	3.19	3.38	
	SM	*(7110.65--Small)*	3.18	3.08	3.19	3.19	3.19	3.38	

D/D (MIN)	*LEAD DEP*	*TRAIL DEP*---	HVY	757	LJ	LC	MED	SM	for 11/29
	HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00	
	757	*(7110.65--757)*	1.50	1.50	1.50	1.50	1.50	1.50	1.5 using radar
	LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83	
	LC	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83	
	MED	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	0.58	
	SM	*(7110.65--Small)*	0.83	0.75	0.75	0.75	0.75	0.58	

Departures on parallel runways use Radar separations -- Revised 8/28/97.
Departures on Runway 29 use 2 minute separations -- Revised 8/28/97.

D/A (NM)	*LEAD DEP*	*TRAIL ARR*---	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	1.57	1.46	1.52	1.52	1.52	1.52	
	757	*(7110.65--757)*	1.57	1.46	1.52	1.52	1.52	1.52	
	LJ	*(7110.65--Large)*	1.57	1.46	1.52	1.52	1.52	1.52	
	LC	*(7110.65--Large)*	1.57	1.46	1.52	1.52	1.52	1.52	
	MED	*(7110.65--Small)*	1.57	1.46	1.52	1.52	1.52	1.52	
	SM	*(7110.65--Small)*	1.37	1.28	1.32	1.32	1.32	1.32	

A/D (Min.) separations are the Runway Occupancy Times (ROTs) from Observed Field Data of December 1996.

*Values include missed approach buffer, which is approximately 1 NM.

The A/A and D/A separations are based on the EWR approach speeds 145, 135, 140, 140, 140, 140. The D/D separations are based on departure occupancy times. D/A separations are based on departure occupancy times and arrival approach speeds. Therefore, Medium (Small Commuters) have the same separations as LC (Large Commuters). The A/A separations for Medium are based on the minimum separations of a Small and the missed approach buffer for a Medium, which has an approach speed of 140 knots.

Classes:

- HVY = Heavy
- 757 = 757
- LJ = Large Jet
- LC = Large Commuter (Large Commuters & Small Regional Jets)
- MED = Medium -- Small Commuters & Business Jets **(treated as Small for separations purposes)**
- SM = Small twin & single engine props

EWR IFR (RADAR) SEPARATIONS

Accepted by EWR Team on 6/28/97.
D/D separations – Revised on 8/28/97.

(In-trail Separations on Same Runway)

A/A (NM)*	*LEAD ARR*	*TRAIL ARR*—	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	5.20	6.12	6.16	6.16	7.16	7.16	
	757	*(7110.65--757)*	5.20	5.12	5.16	5.16	6.16	6.16	
	LJ	*(7110.65--Large)*	3.70	3.62	3.66	3.66	5.16	5.16	
	LC	*(7110.65--Large)*	3.70	3.62	3.66	3.66	5.16	5.16	
	MED	*(7110.65--Small)*	3.70	3.62	3.66	3.66	3.66	3.66	
	SM	*(7110.65--Small)*	3.70	3.62	3.66	3.66	3.66	3.66	

D/D (MIN)	*LEAD DEP*	*TRAIL DEP*—	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00	
	757	*(7110.65--757)*	1.50	1.50	1.50	1.50	1.50	1.50	1.5 using radar
	LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00	
	LC	*(7110.65--Large)*	1.60	1.60	1.60	1.00	1.00	1.00	**Includes Prop/Jet**
	MED	*(7110.65--Small)*	1.60	1.60	1.60	1.00	1.00	1.00	**Separation Based on**
	SM	*(7110.65--Small)*	1.60	1.60	1.60	1.00	1.00	1.00	**EWR/Data Collection**

Departures on parallel runways use Radar separations – Revised 8/28/97.
Departures on Runway 29 use 2 minute separations – Revised 8/28/97.

D/A (NM)	*LEAD DEP*	*TRAIL ARR*—	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	2.00	2.00	2.00	2.00	2.00	2.00	
	757	*(7110.65--757)*	2.00	2.00	2.00	2.00	2.00	2.00	
	LJ	*(7110.65--Large)*	2.00	2.00	2.00	2.00	2.00	2.00	
	LC	*(7110.65--Large)*	2.00	2.00	2.00	2.00	2.00	2.00	
	MED	*(7110.65--Small)*	2.00	2.00	2.00	2.00	2.00	2.00	
	SM	*(7110.65--Small)*	2.00	2.00	2.00	2.00	2.00	2.00	

A/D (Min.) separations are the Runway Occupancy Times (ROTs) from Observed Field Data of December 1996.

*Values include missed approach buffer, which is approximately 1 NM.

The A/A and D/A separations are based on the EWR approach speeds 145, 135, 140, 140, 140, 140.

WHO CAN USE THE REDUCED IFR SEPARATIONS (between similar class, non-Heavy aircraft):

LEAD	*TRAIL*—	HVY	757	LJ	LC	MED	SM
HVY	*(7110.65--Heavy)*	---	---	---	---	---	---
757	*(7110.65--757)*	---	---	---	---	---	---
LJ	*(7110.65--Large)*	YES	YES	YES	YES	---	---
LC	*(7110.65--Large)*	YES	YES	YES	YES	---	---
MED	*(7110.65--Small)*	YES	YES	YES	YES	YES	YES
SM	*(7110.65--Small)*	YES	YES	YES	YES	YES	YES

Classes:

- HVY = Heavy
- 757 = 757
- LJ = Large Jet
- LC = Large Commuter (Large Commuters & Small Regional Jets)
- MED = Medium – Small Commuters & Business Jets **(treated as Small for separations purposes)**
- SM = Small twin & single engine props

DEPENDENCIES for PARALLEL RUNWAYS **Accepted by EWR Team on 8/28/97.**

There are A/D and D/A dependencies between the parallel runways because they are closely spaced.

Wake vortex dependencies apply to A/A and D/D operations on EWR's closely spaced parallel runways – 4R/4L, 4L/4R, 22R/22L, and 22L/22R.

WAKE VORTEX DEPENDENCY APPLIES BETWEEN THESE TYPES OF AIRCRAFT

LEAD	*TRAIL*----	HVY	757	LJ	LC	MED	SM
HVY	*(7110.65--Heavy)*	YES	YES	YES	YES	YES	YES
757	*(7110.65--757)*	YES	YES	YES	YES	YES	YES
LJ	*(7110.65--Large)*	---	---	---	---	YES	YES
LC	*(7110.65--Large)*	---	---	---	---	YES	YES
MED	*(7110.65--Small)*	---	---	---	---	---	---
SM	*(7110.65--Small)*	---	---	---	---	---	---

A/A: VFR-1, VFR-2, IFR-1: **Full Dependency for the above pairs of aircraft.**

D/D: VFR-1, VFR-2, IFR-1: **Full Dependency for the above pairs of aircraft.**

A/D: VFR-1, VFR-2: **N/A.**

IFR-1: **Landing assured for the above pairs of aircraft.**
(12 seconds = 0.2 minutes.)
A departure can roll 12 seconds after the arrival crosses threshold.

D/A: VFR-1, VFR-2: **N/A.**

IFR-1: **Full Dependency for the above pairs of aircraft.**

EWR APPROACH SPEEDS (Knots)

Accepted by EWR Team on 6/28/97.

The speed is given in knots for each class of aircraft flying along the common approach defined below. The standard deviation is 5 knots. The model uses three standard deviations in selecting approach speeds. Therefore, the speeds may vary by 15 knots, plus or minus.

The approach speeds were developed from the ANAMS data at EWR. On 5/29/97, the EWR Tower reviewed these speeds and stated they were reasonable.

	Class	H	757	LJ	LC	M	S
EWR - 1997 Observed	Knots	145	135	140	140	140	140

LENGTH OF FINAL COMMON APPROACH (NM)

Accepted by EWR Team on 6/28/97.

For the simulations, the length of the final common approach is defined as the length along which speed control *cannot* be used to separate aircraft.

At the April meeting, the Design Team stated the approach lengths were 5NM. They also said there was a 3NM final in VFR1 for Class S aircraft arriving on Runway 11. The ANAMS data verified those approach lengths and the EWR Tower accepted them on 5/29/97.

The ANAMS data indicated that Class S aircraft on Runway 11 in VFR had an average speed of 137 knots. Because there are approximately 10 Class S arrivals per day at EWR and the simulations would generate the same results, the Technical Center recommends using 5NM and 140 knot for Class S arrivals on all runways in VFR.

	Class	H	757	LJ	LC	M	S
EWR	VFR	5	5	5	5	5	5
EWR	IFR	5	5	5	5	5	5

DEPARTURE RUNWAY OCCUPANCY TIMES (Sec)

Accepted by EWR Team on 6/28/97.

These are the minimum times a departure is on the runway. Runway crossing times and aircraft separations cannot violate these minimums. These values are used to develop the D/A (departure-to-arrival) separations. **On 5/29/97, the EWR Tower stated these values are reasonable and provide the appropriate separations.**

	Class	H	757	LJ	LC	M	S
Standard	Seconds	39	39	39	39	39	34

Source: Standard values used in most design team studies.

H = Heavy
757 = 757
LJ = Large Jet
LC = Large Commuter (Large Commuters & Small Regional Jets)
M = Medium – Small Commuters & Business Jets **(treated as Small for separations purposes)**
S = Small twin & single engine props

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION

Accepted by EWR Team on 6/28/97.

(Arrival Variability Distribution -- Revised 6/12/97)

Amount by which actual arrival time at threshold exceeds expected arrival time at threshold (Minutes)	Distribution of aircraft lateness (%)	Cumulative (%)	
-30	0.8%	0.8%	
-20	2.0%	2.8%	
-15	3.2%	6.0%	Early
-10	6.4%	12.4%	
-5	10.9%	23.3%	
- 2	8.0%	31.3%	
0	5.5%	36.8%	On Time
5	12.8%	49.6%	
10	10.2%	59.8%	
15	8.9%	68.7%	
30	11.3%	80.0%	
45	6.1%	86.1%	Late
60	3.6%	89.7%	
75	7.1%	96.8%	
90	1.8%	98.6%	
120	1.4%	100.0 %	

The arrival aircraft lateness distribution is shown as a cumulative probability. For each arrival, the lateness distribution is sampled and the resulting time is added to the scheduled arrival time. This input varies the arrival time of an aircraft during each iteration of the simulation. This table is read as follows: 0.8% of the aircraft arrived at the threshold at least 30 minutes early; 2.0% arrived between 20-30 minutes early; and 2.8% arrived at least 20 minutes early; etc.

To simulate more realistic conditions, a lateness distribution (arrival variability distribution) is added to the scheduled arrival time. The distribution should represent the average deviation from the scheduled arrival time, excluding delays at the destination airport (EWR).

This distribution was presented in Data Package 3 and accepted by the Design Team on 6/28.97. It was developed from a 1996 Cater Delay Report by removing the average arrival taxi time. Thus, this distribution reflects the actual time at threshold versus expected time at threshold.

Source: 1996 EWR Cater Data -- Actual Time at Threshold versus Expected Time at Threshold.

EWR AIRCRAFT GATE SERVICE TIMES **Accepted by EWR Team on 8/28/97.**

(Minimum Turn-Around Times in Minutes – Revised 8/20/97)

The gate service times (minimum turn-around times) represent the minimum time it takes to service an aircraft – from the time it arrives at the gate until pushback.

To simulate more realistic conditions, the departure time of a continuing arrival is adjusted to assure the aircraft meets its minimum turn-around time. If an aircraft arrives on time, its departure time is not adjusted.

Newark has many International flights which require lengthy turn-around times. Over half of the Heavy aircraft have minimum turn-around times which are at least 1 hour (60 minutes). ADSIM will allow the Design Team to simulate EWR operations using the 3 gate service time distributions for Heavies described below.

For Small aircraft (small twin and single engine props), the minimum turn-around time is for Small cargo operations.

GATE SERVICE TIMES FOR HEAVIES

(used by ADSIM)

Source: Updated 8/20/97
H – Domestic: Domestic Airlines
H – Int'l: CO & Alitalia
H – Other Int'l: Other International Flights

H – DOMESTIC		H – Int'l (Change Terminals)		H – Other Int'l (Terminal B)	
Cumulative		Cumulative		Cumulative	
Time	Prob.	Time	Prob.	Time	Prob.
45	0.55	120	0.19	60	0.33
50	0.73	140	0.28	90	0.61
60	1.00	150	1.00	100	0.71
				120	1.00

757		LJ		LC		M		S	
Cumulative		Cumulative		Cumulative		Cumulative		Cumulative	
Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.
45	0.22	30	0.31	20	0.16	15	0.29	45	1.00
50	0.87	35	0.88	30 *	1.00	20	0.41		
60 *	1.00	40	0.91			30	1.00		
		45 *	1.00						

* Note:

Five percent (5%) of 757s are International flights which have minimum turn-around times of 150 minutes. Two percent (2%) of Large Jets are International flights which have minimum turn-around times of 90 minutes. Four percent (4%) of Large Commuters are Air Canada flights which have minimum turn-around times of 55 minutes. These times may be used when simulating International operations.

Source: Provided by the Airlines Serving EWR in March 1997.

SIMULATED DEMAND CHARACTERISTICS

Accepted by EWR Team on 8/28/97.

ANNUAL & DAILY DEMAND

DEMAND LEVEL	ANNUAL OPERATIONS	DAILY OPERATIONS	EQUIVALENT DAYS
1996	454,000	1,452	313
FUTURE 1	500,000	1,597	313
FUTURE 2	550,000	1,757	313

NOTE: (Annual Operations) / (Daily Operations) = Equivalent Days

EWR DEMAND CHARACTERISTICS

Annual Distribution of Traffic

DEMAND	AIR CARRIER		COMMUTER/AIR TAXI		GA & MILITARY		TOTAL	
1996	323,000	71.1%	111,000	24.4%	20,000	4.4%	454,000	100.0%
FUTURE 1	350,000	70.0%	130,000	26.0%	20,000	4.0%	500,000	100.0%
FUTURE 2	379,000	68.9%	151,000	27.5%	20,000	3.6%	550,000	100.0%

NOTES: **1996 distribution was based on the 1996 CATER data & Port's statistics.**
Commuter & GA/MI counts were changed so that Air Taxis are included with Commuters.
FAA Technical Center developed the FUTURE 1 & FUTURE2 distributions based on the following growth assumptions of the Port's forecasts for EWR:

* The number of GA & MI annual operations would remain constant.
* 41.7% of the increase in annual operations would be Commuters/Air Taxis.
* 58.3% of the increase in annual operations would be Air Carriers.
* 1996 would have 421,000 Air Carrier/Commuter/Air Taxi annual operations.
* FUTURE 1 would have 467,000 Air Carrier/Commuter/Air Taxi annual operations.
* FUTURE 2 would have 517,000 Air Carrier/Commuter/Air Taxi annual operations.

Daily Distribution of Traffic

AIR CARRIER & COMMUTER/AIR TAXI		GA & MILITARY		TOTAL	
1,388	95.6%	64	4.4%	1,452	100.0%
1,533	96.0%	64	4.0%	1,597	100.0%
1,693	96.4%	64	3.6%	1,757	100.0%

SIMULATED DEMAND CHARACTERISTICS (cont.) Accepted by EWR Team on 8/28/97.

Overall -- Daily Fleet Mix By Class **7/31/97-- Revised all mixes (BA41 is now a LC)**

H		757		LJ		LC		M		S		Total		
124	8.5%	118	8.1%	772	53.2%	304	20.9%	114	7.9%	20	1.4%	1,452	100.0%	Baseline
254	15.9%	284	17.8%	584	36.6%	336	21.0%	119	7.5%	20	1.3%	1,597	100.0%	Future 1
282	16.1%	314	17.9%	644	36.7%	370	21.1%	127	7.2%	20	1.1%	1,757	100.0%	Future 2

Air Carrier/Commuter/Air Taxi -- Daily Fleet Mix By Class **7/31/97-- Revised all mixes (BA41 is now a LC)**

H		757		LJ		LC		M		S		Total		
124	8.9%	118	8.5%	768	55.3%	294	21.2%	80	5.8%	4	.3%	1,388	100.0%	Baseline
254	16.6%	284	18.5%	580	37.8%	326	21.3%	85	5.5%	4	.3%	1,533	100.0%	Future 1
282	16.7%	314	18.5%	640	37.8%	360	21.3%	93	5.5%	4	.2%	1,693	100.0%	Future 2

GA & Military -- Daily Fleet Mix By Class

H		757		LJ		LC		M		S		Total		
0	.0%	0	.0%	4	6.3%	10	15.6%	34	53.1%	16	25.0%	64	100.0%	Baseline
0	.0%	0	.0%	4	6.3%	10	15.6%	34	53.1%	16	25.0%	64	100.0%	Future 1
0	.0%	0	.0%	4	6.3%	10	15.6%	34	53.1%	16	25.0%	64	100.0%	Future 2

NOTES: **7/31/97 -- Fleet Mixes were revised at all demands; BA41 was reclassified as a Large--an LC in EWR study.**

Baseline Demand Characteristics developed from CATER data.

Overall fleet mix -- from Cater data, Calendar Year 1996.

GA/MI fleet mix -- from Cater data, 8/22/96 -- assumed daily mix similar to annual mix.

AC/Commuter/AT fleet mix -- computed from the other Baseline fleet mixes.

Future 1 Demand Characteristics developed as follows: -- Revised 7/7/97

GA/MI fleet mix -- same as GA/MI fleet mix in Baseline Demand.

AC/Commuter/AT fleet mix -- estimated from forecast data provided by the Port.

Overall fleet mix -- computed from the other Future 1 fleet mixes.

Future 2 Demand Characteristics developed as follows: -- Revised 7/7/97

GA/MI fleet mix -- same as GA/MI fleet mix in Baseline Demand.

AC/Commuter/AT fleet mix -- same as Future 1 AC/Commuter/AT fleet mix.

Overall fleet mix -- computed from the other Future 2 fleet mixes.

EWR AIRLINE GATE ASSIGNMENTS

Accepted by EWR Team on 8/28/97.
Updated C2 & C3 on 10/28/97.

AIRLINE(S)	OAG CODE	FAA CODE	TERMINAL/GATES
Air Alliance		AAQ	C2: C100-C115
AirBC	ZX	ABL	?
Air Canada	AC	ACA	C2: C100-C115
Air Canada Commuters	AC	ACA	C3
Air Nova	QK	ARN	C2: C100-C115
Alitalia	AZ	AZA	B3 & C1: B60-B68, C70*-C79
American	AA	AAL	A3: A30-A35
America West	HP	AWE	C2: C120
America West Commuters	HP	AWE	C3
Business Express		GAA	B1: B43-B48
Carnival	KW	CAA	B1: B40-B42
Chautauqua		CHQ	A2: A25-A26
Colgan Air	9X	CJC	A3: A36-A39
Comair		COM	B1: B43-B48
Continental	CO	COA	C1 & C2: C70*-C120
Continental Express	CO	BTA	C3: C130-C134
Delta	DL	DAL	B1: B43-B48
International Departures only			B:2 B51-B57 (Int'l)
International Facility			B3: B60-B68 (Int'l)
Jet Express	JI	YPX	A3
Jet Train Corporation	LF	JTN	A3
Kiwi International	KP	KIA	A3: A30-A35
Midway		MDW	A3: A30-A35
Midwest Air Express	YX	MEP	B1: B40-B42
Monarch		MON	A3: A36-A39
Myrtle Beach			B1: B40-B42
Northwest	NW	NWA	B1: B40-B42
Trans World Airlines	TW	TWA	A3: A36-A39
Scandinavian Airlines	SK	SAS	B3
Sun Country (Charter)	SY	SCX	A3: A36-A39
Sun Jet		SJI	A3: A36-A39
SwissAir	SR	SWR	B1 & B2: B43-B48, B51-57
United	UA	UAL	A1: A10-A18
United Express (Atlantic Coast)	UA	UAL	A1: A10-A18
US Airways	US	USA	A2: A20-A24, A27-A28
USAir Express (Allegheny, Commutair, Henson)	US	USA	A2: A25-A26
Western Pacific		KMR	B1: B43-B48

Notes: 10/28/97: Updated C2 and C3.
9/5/97: Updated Jet Express, Jet Train Corp., and Scandinavian Airlines.
* Gate C70 is not operational.
The International Facility is located in Terminal B. Not all International Carriers are shown.
Cargo operators: EB (Emery), ER (DHL), FX, 1A, 1F (Airborne), 1V, 5X (UPS), 8W.

EWR GATE MAP

Accepted by EWR Team on 8/28/97.
Updated Gates C2 & C3 on 10/28/97